

EXPANDED DISTRIBUTION OF *ISOËTES BUTLERI* (ISOËTACEAE) IN TEXAS

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ABSTRACT

More than 125 *Isoetes butleri* populations are reported from 11 additional counties in north central Texas. These collections bridge the 450 km disjunction between Oklahoma and central Texas records. SEM examination of megaspore ornamentation and size confirm the determination. Descriptions of sites, population sizes, associated plants, soils, and species characteristics are included and discussed.

RESUMEN

Se registran más de 125 poblaciones de *Isoetes butleri* de 11 condados adicionales en norte central de Texas. Estas colecciones unen la disyunción de 450km previamente observada que separaba las poblaciones de Oklahoma y Texas. Las identificaciones se confirmaron usando un microscopio electrónico de barrido para observar la ornamentación y tamaño de las megasporas. Se incluyen descripciones de localidades, tamaños de poblaciones, las plantas asociadas, los suelos y las características de la especie.

Isoetes butleri Engelm. is known to occur in Tennessee, Kentucky, Alabama, Arkansas, Missouri, Kansas, Oklahoma (Baskin & Baskin 1978), Georgia (Boom & Evans 1979), Illinois (Mohlenbrock 1955), and Texas (Lott et al. 1982). The species is most abundant in the cedar glades of the Tennessee Central Basin and the Ozark region of Missouri and Arkansas where it typically grows in seasonally saturated soil over exposed limestone bedrock (Taylor & Schwegman 1992).

Baskin and Baskin (1978) note that *I. butleri* is only known from "calcareous glades" in the southeastern United States. While various authors indicate that it is also found on sandstone (Taylor et al. 1975; Lott et al. 1982), it has been suggested that "the sandstone substrate may be cemented together by a calcareous matrix which, in effect, creates the normal pH conditions" (Lott et al. 1982). The relatively recent documentation of *I. butleri* in the Edwards Plateau of Texas represents a disjunction of about 450 km (Lott et al. 1982). Hansen (2010) discovered populations in Bell and Coryell counties approximately 100 km to the northeast of Llano Co. in the Lampasas Cut Plain.

Holmes et al. (2005) discovered populations of *I. butleri* in glauconite glade pools of the Weches Formation in San Augustine and Sabine counties in eastern Texas. These locations represent a disjunction of 250 km to the south of locations in Miller Co., Arkansas and over 300 km to the east of locations in Bell Co. The Weches formation comprises a narrow strip approximately 650 km long from northeast to south-central Texas.

In June 2003, O'Kennon and Caren McLemore collected a specimen that they identified as *I. melanopoda* (18645, BRIT) from a Walnut Limestone seep in the Lyndon B. Johnson National Grasslands in Wise Co., Texas. Upon examination of this specimen and additional collections from the same location (Norton & O'Kennon 1394, BRIT; Rehman, O'Kennon, Norton, Barfield 371, BRIT), the authors determined that it is actually *I. butleri* (Taylor et al. 1993). This population represents the first known location for *I. butleri* in north central Texas, over 240 km north of Hansen's 2010 collections in the Lampasas Cut Plain.

In May 2010, O'Kennon, Franklin, and Barfield collected *Isoetes butleri* (22362, BRIT) from a Walnut Limestone seep at the Fort Worth Nature Center and Refuge in Tarrant Co., Texas. Scanning electron micrographs (Fig. 1) showed megaspores averaging approximately 500 µm in diameter and megaspore ornamentation consistent with that described by Taylor et al. (1975). The limestone substrate at both the Wise and Tarrant Co. sites is consistent with previous indications that the species is calciphilous (Baskin & Baskin 1978; Taylor & Taylor 1981; Lott et al. 1982; Taylor & Schwegman 1992).

In the spring of 2012, the authors conducted an extensive search in north central Texas around Fort

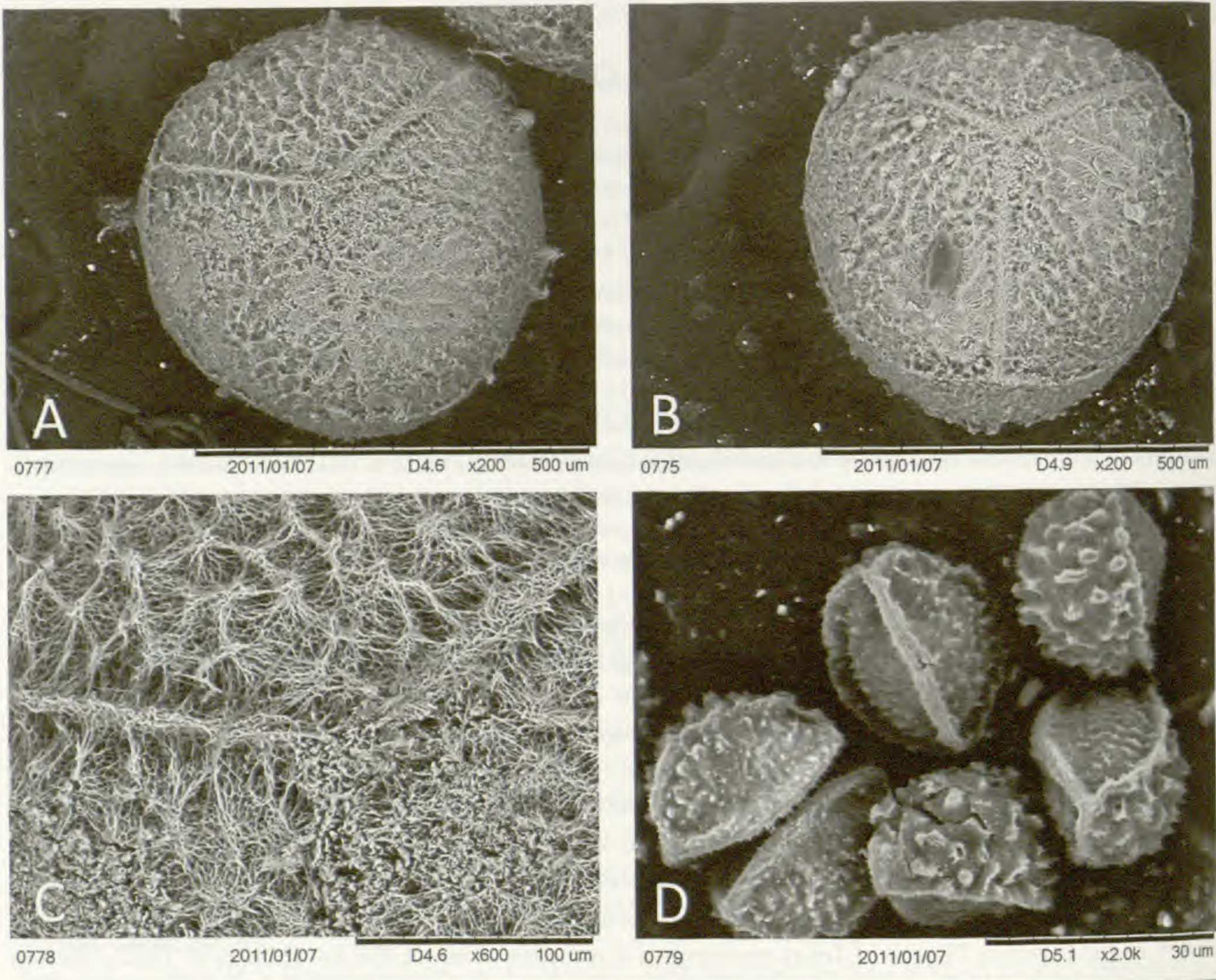


FIG. 1. SEM micrographs of *Isoetes butleri* megaspores and microspores, O’Kennon, Franklin, Barfield 22362 (BRIT). A–B. Megaspores; C. Megaspore ornamentation; D. Microspores.

Worth. Areas where limestone outcrops formed “glades” reminiscent of those found in the Central Basin of Tennessee were searched for *I. butleri*. Satellite imagery and geologic maps were used to identify other possible locations for exploration. Over 125 new locales were confirmed for *I. butleri*. These collections represent 11 new county records, including Bosque, Cooke, Denton, Erath, Hood, Johnson, Montague, Parker, Somervell, Tarrant, and Wise counties (Fig. 2). At least one voucher specimen from each county was collected and deposited in the BRIT herbarium. High resolution images of each specimen are available online at <http://atrium.brit.org/>.

All sites are underlain by Cretaceous limestone with the majority being Walnut Limestone, Grayson Marl, Goodland/Comanche Peak Limestone, and Duck Creek Limestone. The majority of the sites (109 of 125) were found on seasonally saturated seeps underlain by Walnut Limestone. This hard, fossil rich limestone has a tendency to outcrop, producing glades. These glades often form at lower topographic positions as the eroding soil uncovers the hard limestone bedrock below. Seepage from upslope often forms pools over the impenetrable bedrock. *Isoetes butleri* was found in shallow soil ranging from less than 2 cm at the bottom of the slope to approximately 15 cm up slope.

Isoetes butleri is most abundant in areas with little competing vegetation, and can often form a dense monoculture. Most sites were estimated to have between 100 and 1000 plants. Transects at the Acton Nature Center in Hood Co., and at the Rough Creek Lodge on the Somervell – Erath Co. line each resulted in an estimate of well over 100,000 individuals. Sites ranged in size from a few square meters to 2.5 ha. Associated spe-

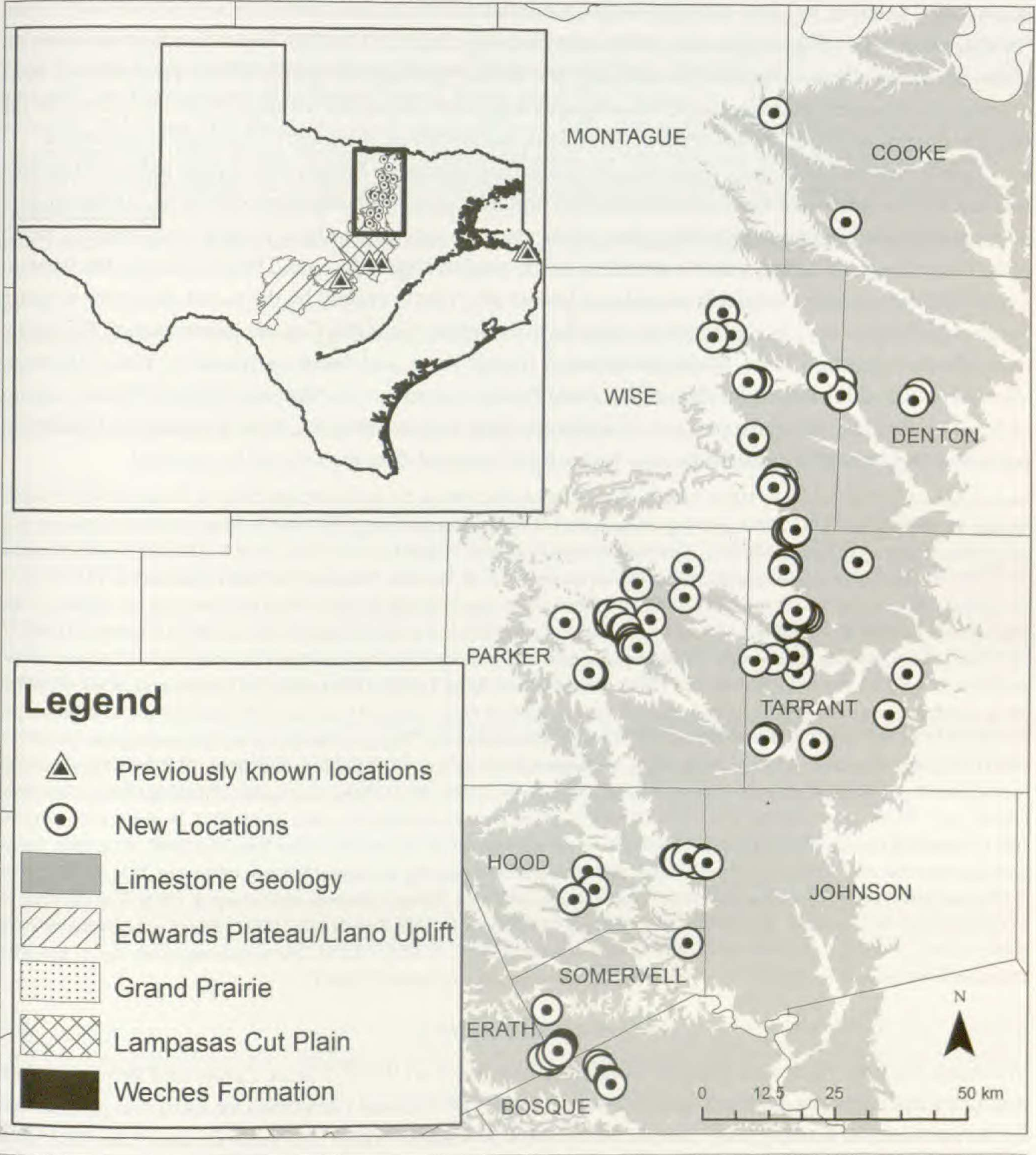


Fig. 2. Locations of currently known *Isoetes butleri* sites in Texas.

cies include *Eleocharis occulta* S.G. Sm., *Juncus filipendulus* Buckl., *Hypoxis hirsuta* (L.) Coville, *Spiranthes magnicamporum* Sheviak, *Gratiola quartermaniae* D. Estes, *Nothoscordum bivalve* (L.) Britton, *Allium canadense* var. *fraseri* Ownbey, and *Muhlenbergia reverchonii* Vasey & Scribn.

Plants become evident in early March and above ground sporophylls begin to yellow by mid-May and disappear almost completely by mid-June, which is consistent with previous observations (Baskin & Baskin 1978; Taylor & Schwegman 1992). All plants collected were dioecious, with gynoecious and androecious individuals growing adjacent to one another. Gynoecious plants are easily distinguished by the presence of megaspores which develop in mid-April. The evidence of dioecy in these north central Texas individuals is consistent with much of the published literature (Engelmann 1878; Taylor & Schwegman 1992; Turner et al 2005).

Boom (1982) however, suggests that genetically based dioecy does not exist for the species and cites a specimen "in which both types of sporangia were on the same plant (e.g., Kral 52572, VDB)." Upon thorough examination of this specimen, all plants appeared to have only one form of sporangia. Megaspores were present in the roots of some plants bearing microsporangia, but megasporangia were absent and the spores were likely found in the soil. It is our opinion that *I. butleri* is indeed dioecious, but further examination of this issue is warranted.

Isoetes butleri is much more widespread in Texas than previously known. The cryptic nature of this species has likely contributed to its misidentification and the paucity of herbarium collections. At first glance, above ground parts appear to resemble culms of the associate species *Eleocharis occulta*. Until recently, much of the limestone glade habitat which is abundant on the western edge of the Grand Prairie and into the Western Cross Timbers remained relatively unexplored botanically. This is evident by the recent discovery or range expansion of several species characteristic of glades in the region, including *Gratiola quartermanniae*, *Phemeranthus calycinus* (Engelm.) Kiger, *Minuartia michauxii* (Fenzl) Farw., and *Dalea reverchonii* (S. Wats.) Shinnery. We believe that additional exploration of the Grand Prairie, Lampasas Cut Plain, and Edwards Plateau regions of Texas would likely reveal the presence of additional glade taxa in addition to more locations for *I. butleri*. In particular, regions with exposed limestone bedrock and seasonal saturation should be searched.

Representative Voucher Specimens. **U.S.A. TEXAS. Bosque Co.:** Co Rd 2650 ca. 0.7 mi SE of Co Rd 2660, ca. 3.5 air mi NW of Walnut Springs, 32.087772, -97.795782, 297 m, growing in seasonally wet Walnut Limestone seep with water pooling on exposed limestone bedrock at base of slope, abundant, 28 Mar 2012, Norton & O'Kennon 1481 (BRIT). **Cooke Co.:** FM 373 ca. 0.5 mi N of FM 922, 4 mi E of Rosston, 33.51212, -97.38164, 269 m, approximately 50 plants in wet roadside seep, 21 Apr 2012, O'Kennon 24978 (BRIT). **Denton Co.:** FM 156 ca. 1.5 mi S of Hwy 380 ca. 4.5 mi W of Denton, 33.222563, -97.258846, 210 m, approximately 50 plants in wet limestone seep on roadside, 21 Apr 2012, O'Kennon 24983 (BRIT). **Erath Co.:** Rough Creek Lodge, Co Rd 2013 ca. 4.2 mi SE of hwy 67, 10.4 mi SW of Glen Rose, 32.097517, -97.879603, 311 m, growing in seasonally wet Walnut Limestone seep with water pooling on exposed limestone bedrock at base of slope, abundant, 27 Apr 2012, Norton & O'Kennon 1671 (BRIT). **Hood Co.:** Peak Rd ca. 2 mi SE of Paluxy Hwy, S of Granbury, 32.38345, -97.80091, 318 m, growing in thin soil over Walnut Limestone on N side of Comanche Peak, 27 Apr 2012, Norton & O'Kennon 1664 (BRIT). **Johnson Co.:** Co Rd 1233A ca. 0.3 mi NE of FM 4/Cleburne Hwy between Decordova and Cleburne, abundant in wet limestone glade, 32.429217, -97.611739, 236 m, 7 Apr 2012, O'Kennon 24834 (BRIT). **Montague Co.:** FM 2382 ca. 0.7 mi E of St. Jo, 33.695964, -97.506674, 352 m, growing in swale on side of road, approximately 20 plants, 21 Apr 2012, O'Kennon 24982 (BRIT). **Parker Co.:** Corner of Highland Rd and New Highland Rd, ca. 3 mi SW of Springtown, 32.926796, -97.647542, 310 m, growing in limestone swale, 10 Apr 2012, Norton & O'Kennon 1537 (BRIT). **Somervell Co.:** Rough Creek Lodge, Co Rd 2013 ca. 4.2 mi SE of hwy 67, 10.4 mi SW of Glen Rose, 32.122892, -97.857961, 326 m, growing in wet clay over Walnut Limestone bedrock, glade seep with water pooling on exposed bedrock, infrequent, 28 Mar 2012, Norton & O'Kennon 1470 (BRIT). **Tarrant Co.:** Fort Worth Nature Center and Refuge, Walnut Limestone Muhly Seep ca. 150 m W of entry gate on Confederate Park Rd, 32.829340, -97.477730, 207 m, 26 May 2010, O'Kennon, Franklin, Barfield 22362 (BRIT). **Wise Co.:** LBJ National Grasslands, Unit 49, ca. 0.5 mi E of Fs 910 and Co Rd 2360 down unmarked road, 33.3201, -97.5781, 290 m, growing in wet clay, 27 Jun 2003, O'Kennon & McLemore 18645 (BRIT); 16 June 2011, Rehman, O'Kennon, Norton, Barfield 371 (BRIT).

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